Fall 2020

# ME 430-001: Introduction to Computer Aided Design

Swapnil Moon

**Mechanical and Industrial Engineering Department**
**ME430 Introduction to Computer Aided Design** **3 Credits**

NJIT New Jersey's Science & Technology University

## COURSE OUTLINE

**Prerequisites** CIS 101, Math 222

**Instructor** Dr. Swapnil Moon Office: MEC 333 CD
Phone: 201-665-2223 E-mail: swapnil.moon@njit.edu

**Office Hours** Wednesday 11:00 – 1:00 & By Appointment

**Textbook** Instructor's Lecture Notes

**Reference** Mastering CAD/CAM by I. Zeid, McGraw-Hill, New York, 2005
ISBN 0-07-286845-7

**Course Description** This is a course introducing basic concepts of CAD (Computer Aided Design) and structural and thermal as applied to Mechanical Engineering design problems. Topics include geometric modeling, computer graphics, projections, database, mechanism design, structure and thermal FEA (Finite Element Analysis), optimization for design models. The laboratory component involves use of current CAD software packages for mechanical design.

**Grading Scheme & Policies:**

| | |
|---|---|
| Lab Work – Assignments | 40% |
| Projects | 20% |
| Mid-Term Exam | 20% |
| Final Exam | 20% |
| e-Portfolio | 5% (Bonus) |

***Course Policies:***

1. Attending class, completing assignments on time, and keeping up with the class material is important for success in this course and in college. Generally, late or missed assignments **will not** be accepted except for legitimate **(pre-approved when possible)** reasons as determined by the instructor. Examples of legitimate reasons are: illness, death in family, etc. **The method of handling late or missed work is determined by the instructor.**
2. **Missing more than 4 classes will lead to an 'F' grade in the course.** Exceptions will only be made for cases of excused absences supported by relevant documentation submitted to and verified by the office of Dean of Students.
3. **Attending progress meetings scheduled throughout the semester is mandatory**
4. **ANY FORM OF CHEATING ON ASSIGNMENTS OR EXAMS WILL RESULT IN AN 'F' FOR THE COURSE**. This includes looking at another person's exam or copying another person's work for exams or assignments.
5. NJIT honor code will be used for all situations that involve cheating, copying, misrepresentation of student work, and misrepresentation

of student information and any violations will be brought to the immediate attention of the Dean of Students **(visit http://www.njit.edu/academics/honorcode.php).**

6. The **part file** for the assignment is required to be submitted to get credit for the assignment. Non submission of the part file will lead to a loss of grade for the assignment.
7. Weekly assignments are due on the first meeting of the class for the week (Monday or the appropriate first day of class for the particular section) **BEFORE** the start of Lecture. Assignments turned in after the lecture starts are counted as late.
8. **Assignments that are more than 2 weeks late will not be accepted**.
9. Point deduction – Late Assignments: 1-Week-20%, 2-Weeks-30%
10. **At least 60% of the homework has to be submitted for a passing grade.**
11. Not submitting the final project will lead to an 'F' in the course.
12. Attendance, attitude, class participation and effort can and will be used to change borderline grades up or down.
13. For special allowances associated with disabilities student must approach the Disability Resource Center.
14. For any modifications or deviations from the syllabus throughout the course of the semester, instructor will consult with students and the students must agree to.

**ACADEMIC INTEGRITY**

**"Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at:**

http://www5.njit.edu/policies/sites/policies/files/academic-integrity-code.pdf

Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. **Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university.** If you have any questions about the

code of Academic Integrity, please contact the Dean of Students Office at dos@njit.edu"

**Administration of Exams**

- Exams will be administered using either a combination of Respondus + Lockdown Browser and Webex or through ProctorU Review+.
- Students need to have access to a laptop to be able to take the exam using the above mentioned tools.
- NJIT honor code will be strictly adhered to, any violations will be processed through the office of Dean of students.

***NJIT Makerspace:*** As a part of this course students are required to complete the training in the following Makerspace courses:
Make 101 - Introduction to the Makerspace (This course introduces users to the policies and safety procedures of the space and provides basic training for simple hand tools)
Make 103 - Introduction to 3D Printing (Briefly covers the basics of 3D printing including basic maintenance and operation, model preparation and slicing, starting, monitoring, and removing a print)

**List of software tools covered :**
Creo Parametric, Creo Simulate, Creo Sheetmetal, Creo Mechanism
Solidworks, Solidworks Sheetmetal, Solidworks Simulate, Solidworks Mechanism
Ultimaker CURA

## Tentative Course Outline:

| Week Number: | TOPICS | ASSIGNMENTS |
|---|---|---|
| 1) 9/1 | Course Introduction, Product Life Cycle and Roles of CAD in Design Process (Synthesis and Analysis)<br><br>Structure of Software GUI and Basic & Advanced Types of Protrusion | **Creo Parametric**: Base Support, Card Holder & Helical Extension Spring. |
| 2) 9/8 | CAD/CAM Hardware – CAD/CAM Systems – Hardware Configurations (Mainframe, Workstation and PC Configurations). | **Creo Parametric**: Hammer Handle, Cam, Razor Handle & Clip. |
| 3) 9/15 | CAD/CAM Hardware – Hardware Integration and Networking.<br><br>CAD/CAM Software – Database Coordinate Systems and Sketch Planes (Working Coordinate System, Model Coordinate System, and Screen Coordinate System - Projections). | **Creo Parametric**: Bottle, Pump Housing, Basket Ball Rim & Involute Gear. |
| 4) 9/22 | Model Representation Schemes – Wireframe Modeling, Surface Modeling, and Solid Model Creation Techniques (Constructive Solid Geometry, Boolean Operations, and Parametric Modeling) | **Creo Parametric**: Pinion Gear Shaft Detailed Drawing, Aux. View of Control Bracket Detailed Drawing & Brake Rotor. |
| 5) 9/29 | Dimensioning & Tolerancing Techniques<br>Multi-view Projections & Auxiliary View<br>Type of Sectional Views<br><br>Assembly Design Modeling – Assembly Constraints | **Creo Parametric**: Roller Chain Assembly, Roller Chain Assembly Detailed Drawing & Bicycle Chain Assembly.<br>Make-101/Make-103 Training |
| 6) 10/6 | CAD/CAM Software – Matrices of Coordinate Systems Transformation: Homogeneous Coordinate System, and Mathematical Development of Working, Model & Screen Coord. Systems Relationships. | **SolidWorks:** Idler Arm, Shaft Hanger, Drill Press Bracket & Split Cotter Pin. |
| 7) 10/13 | Optimization<br><br>Mechanism Design – Kinematics and Dynamics Analyses in CAD. | **SolidWorks:** Landing Gear Assembly, Detailed Drawing of Housing Cover & Assembly drawing of Landing Gear. |

| | | |
|---|---|---|
| 8) 10/20 | **Mid-term Exam I**<br><br>**Curves Representation – Analytical and Free Form Curves: Bezier, B-Spline & NURBS** | **SolidWorks:**<br>Support Bracket – Sheet Metal |
| 9) 10/27 | Mechanism Design – Type of Joints and Degree of Freedom in Mechanism Design | **SolidWorks:**<br>Car Wheel Assembly.<br>**Creo Parametric**: Crankshaft Balancing and Optimization. |
| 10) 11/3 | Introduction to Plastic Injection Machines.<br><br>Theory of Failures – von Mises Stress etc.<br><br>Finite Element Analysis (FEA) – P-Method and H-Method, Steps in FEA Modeling, Convergence Techniques | **Creo Parametric**: Slider Crank Mechanism, Eccentric Mechanism & Valve Cam Mechanism. |
| 11) 11/10 | FEA – 2-D and 3-D Analysis, Element Types, Singularities | **Creo Parametric & Simulate**: Structural Analysis of Guide Block & Thermal Analysis of Computer Chip Assembly.<br><br>**SolidWorks Simulation**: Static Structural Analysis Of Pulley Support |
| 12) 11/17 | Matrices of Geometric Transformation – Translation, Scaling, Reflection & Rotation | **SolidWorks Simulation**: Steady State Thermal Analysis Of Heatsink.<br><br>**Creo MANUFACTURE:** Plate Milling and Drilling Using Expert Machinist.<br><br>Start to create parts for Final Project |
| 13) 11/24 | Standards Exchange Between CAD Systems – Direct method and Neutral files (IGES, DXF, and STEP) | Working on the Final Project. |
| 14) 12/1 | | Working on the Final Project. |
| 15) 12/8 | | Working on the Final Project. |

Homework related to the lectures will be assigned, collected and graded.

The laboratory will have hands-on sessions to cover the basics and advanced features of Creo Parametric, Simulate & SolidWorks.